

BOARD OF PATENT APPEALS AND INTERFERENCES
UNITED STATES PATENT AND TRADEMARK OFFICE

REQUEST FOR REHEARING

APPLICANT(S): Mitsuhiro Nakamura, et al. OLD DOCKET NO.: P97,0322
APPEAL NO.: 2000-0456 NEW DOCKET NO.: 09794353-0005
SERIAL NO.: 08/809,463 GROUP ART UNIT: 2814
DATE FILED: July 18, 1997 EXAMINER: N. Kelley
INVENTION: "MULTI-LAYERED STRUCTURE FOR FABRICATING AN
OHMIC ELECTRODE AND OHMIC ELECTRODE"

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Hon. Assistant Commissioner for Patents
Washington, DC 20231

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In accordance with the provisions of 37 C.F.R. §1.197, Appellants herewith submits this Request for Rehearing in response to the Decision on Appeal issued by the Board of Patent Appeals and Interferences ("the Board") on November 28, 2000 in the above-referenced appeal.

This Request for Rehearing is being submitted within two months from the date of the original Decision on Appeal of the Board, and is therefore in compliance with 37 C.F.R. §1.197(b) and no fee is necessary. Please charge any additional fees which may be due and owing or credit any overpayment to Deposit Account No. 19-3120.

In the Decision on Appeal dated November 28, 2000, the Board affirmed the decision of the Examiner rejecting claims 1-4, 7, 9-14, 17 and 19 under 35 U.S.C. §103(a) as obvious over *Jackson et al.* in view of *Nirschl et al.*, and claims 5, 6, 8, 16 and 18 under 35 U.S.C. §103(a) as obvious over *Jackson et al.* in view of *Nirschl et al.* and further in view of *Ishihara et al.* The Appellants respectfully request a rehearing based on the arguments set forth below.

It is respectfully submitted that the Board misapprehended and overlooked specific points of fact in rendering its decision.

For the purposes of this Request for Reconsideration, Appellants' independent claim 1 is representative of Appellants' claimed invention. Appellants' independent claim 1 claims a multi-layered structure for fabricating an ohmic electrode. (Claim 1). The ohmic electrode comprises a III-V compound semiconductor body, a non-single crystal semiconductor layer comprising indium over the semiconductor body, and a metal nitride film over the indium layer. (Claim 1).

As discussed in the specification, indium which is present in the non-single crystal semiconductor layer tends to diffuse toward a surface of the electrode during annealing. (Page 5, line 25 - page 6, line 5). This diffusion of indium to the electrode surface during annealing disadvantageously degrades surface morphology and increases the contact resistance. (Id.) Degraded surface morphology is indicative of course electrode surfaces and edges. (Id.) Increased contact resistance of the electrode results in reduced thermal stability of the electrode. (Id.) Appellants' claimed multi-layered structure comprises a metal nitride film, which prevents this diffusion of indium from the non-single crystal semiconductor layer to the electrode surface. (Page 9, line 25 - page 10, line 2).

To illustrate the unexpected and improved results of Appellants' claimed multi-layered structure, Appellants present their experimental results in the specification. (Page 17, line 1 - page 20, line 13; Figs. 6 and 7). (Fig. 7 is attached hereto as Appendix A). As discussed, Fig. 7 illustrates changes with time of the contact resistances of ohmic electrodes 7 during annealing for 10 hours at 400 °C. As illustrated, the contact resistance of the ohmic electrode made without a metal nitride layer starts increasing at about one hour after annealing is started. (Fig. 7, ▲ curve). This is due to the diffusion of indium to the electrode surface during annealing. On the other hand, the ohmic electrode having Appellants' claimed multi-layered structure comprising a metal nitride (WN) layer maintains a substantially constant contact resistance even 10 hours after annealing is started. (Fig. 7, ▼ curve). Appellants' metal nitride layer prevents the diffusion of indium to the electrode surface, thus enabling the illustrated contact resistance characteristics. (Page 18, line 25 - page 19, line 12).

Fig. 6, which is attached hereto as Appendix B, illustrates an optical micrograph of the surface of an ohmic electrode 7 having Appellants' claimed multi-layered structure comprising a metal nitride (WN) layer 5. As shown, the surface has good morphology, that is, it has a uniform surface and precisely formed edges. This advantageous morphology results from the existence of the claimed metal nitride (WN) layer 5, which prevented the dispersion of indium from the non-single crystal layer 3 toward the surface of the electrode 7 during annealing. (Fig. 6; Page 17, lines 1-19).

Thus, as illustrated through experimental results, Appellants' claimed multi-layered structure provides unexpected and improved electrode surface morphology and thermal stability by preventing the diffusion of indium to the surface of the electrode.

The Board states that it would have been obvious to combine *Jackson et al.* with *Nirschl et al.* to disclose or suggest Appellants' claimed multi-layered structure. Appellants respectfully

disagree and request a rehearing.

The Board states that *Jackson et al.* differs from claim 1 only in that *Jackson et al.* discloses a metal rather than Appellants' claimed metal nitride film. *Jackson et al.* discloses a metal contact formed on a semiconductor layer comprising indium, which is in turn formed on a semiconductor body. Nowhere does *Jackson et al.* even discuss that indium will diffuse out from its semiconductor layer. As shown by Appellants' experimental results, during annealing the indium in *Jackson et al.*'s semiconductor layer will diffuse into *Jackson et al.*'s metal contact.

As *Jackson et al.* fails to discuss that indium will diffuse out from its semiconductor layer, accordingly, *Jackson et al.* fails to disclose or even suggest including a diffusion barrier placed between its semiconductor layer comprising indium and its metal contact. Thus, *Jackson et al.* fails to disclose both the structure and the function of Appellants' claimed invention.

Further, it is respectfully submitted that the Board has overlooked that fact that *Jackson et al.* specifically teaches away from Appellants' claimed invention by forming a metal contact directly on a semiconductor layer comprising indium. *Jackson et al.* purposefully forms its metal contact directly on its semiconductor layer comprising indium in order improve carrier flow. (Col. 2, lines 7-21). It is this direct interface of metal contact to semiconductor layer comprising indium which permits the free flow of carriers in *Jackson et al.*

The Board states that *Nirschl et al.* teaches that when one is using III-V semiconductors, it is desirable to replace a single metal contact with a metallization series, and that the ohmic contact is improved by adding a metal nitride film over a metal layer. (Decision on Appeal, page 8). Thus, states the Board, "*Nirschl* would have suggested to the artisan that the single metal contact of *Jackson* should be replaced by a metallization series including a metal nitride film for reasons suggested by *Nirschl*". (Decision on Appeal, page 8).

Appellants respectfully submit that there is no suggestion to make the combination of references as stated by the Board. When the Patent Office is making an obviousness rejection based upon more than one reference, there must be some teaching, suggestion or motivation to make that combination whether in the references themselves or in the knowledge generally available to one of ordinary skill in the art. *In re Fine*, 5 U.S.P.Q.2d 1596, 1599 (Fed. Cir. 1988); *In re Jones*, 21 U.S.P.Q.2d 1941, 1943-44 (Fed. Cir. 1992). As stated previously, there is no disclosure in *Jackson et al.* which provides motivation to replace its single-metal contact with anything but a single-metal layer of another metal-type. In fact, as stated above, *Jackson et al.* specifically teaches away from introducing a diffusion barrier by forming its metal contact directly on its semiconductor layer comprising indium. *Jackson et al.* purposefully forms its

metal contact directly on its semiconductor layer comprising indium in order improve carrier flow. (Col. 2, lines 7-21). Thus, one of skill in the art would not have been motivated to introduce a diffusion layer between *Jackson et al.*'s metal layer and *Jackson et al.*'s semiconductor layer comprising indium.

Further, *Nirschl et al.* relates to a different problem than that addressed by Appellants' present invention. As stated by the Board, *Nirschl et al.* provides a multi-layered contact which improves ohmic contact. *Nirschl et al.* also states that its metallization allows reliable operation even at temperatures above 100 °C. While *Nirschl et al.* discusses annealing, it merely states that its diffusion layer does not change its composition during annealing. (See *Nirschl et al.* Derwent Abstract). Unlike Appellants' present disclosure, nowhere does *Nirschl et al.* even discuss the issues of maintaining surface morphology and contact resistance. The fact that the art fails to consider the problem faced by the inventor is indicative of non-obviousness. See *Diversitch Co. v. Century Steps, Inc.*, 850 F.2d 675, 679 (Fed. Cir. 1988).

While the Board states that one of skill in the art would have been motivated to improve the ohmic contact of *Jackson et al.* by incorporating the metallization of *Nirschl et al.*, Appellants respectfully direct the Board to the fact that *Jackson et al.* purposefully forms its metal contact directly on its semiconductor layer comprising indium in order improve carrier flow. (*Jackson et al.*, col. 2, lines 7-21). The introduction of *Nirschl et al.*'s additional metallization layers to *Jackson et al.* will modify the carrier flow characteristics of *Jackson et al.*, a result which *Jackson et al.* purposefully avoids.

Appellants respectfully submit that one "cannot pick and choose among the individual elements of assorted prior art references to create the claimed invention". *Diagnostic, Inc. v. Helena Laboratories Corp.*, 859 F.2d 878, 887 (Fed. Cir. 1988). Instead, unless the prior art suggests the desirability of a modification, the mere fact that the prior art could be modified does not make the modification obvious. *In re Gordon et al.*, 733 F.2d 900, 902 (Fed. Cir. 1984).

Thus, the Board's affirmation of the rejection of the Appellants' invention as obvious over *Jackson et al.* in view of *Nirschl et al.* should be withdrawn and a rehearing conducted. Appellants' claimed invention is distinguishable from *Jackson et al.* in view of *Nirschl et al.* as discussed above. Further, as previously stated in Appellants' Main Brief on Appeal and Reply Brief, it would not have been obvious at the time Appellants' invention was made to combine *Jackson et al.* with *Nirschl et al.* to disclose or suggest Appellants' present invention.

Therefore, Appellants respectfully submit that the Board has improperly affirmed the rejection based on the combination of cited references. The above arguments are directly or indirectly submitted for each of claims 1-19. A rehearing on each of claims 1-19 in light of the arguments presented above is therefore respectfully requested.

Respectfully submitted,

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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited as First Class Mail in an envelope addressed to Commissioner for Patents, Attn. Board of Patent Appeals and Interferences, Washington, D.C. 20231 on January 29, 2001.

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PATENT

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